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Publication 1: JP-A-2000-100545
Publication 2: JP-A-H9-219274
Publication 3: JP-A-H4-209968
Publication 4: JP-A-2000-223239
Publication 5: JP-A-2000-228322
[Reasons for Submission]

1. Purposes

(1) The invention related to claims 1 to 38 of the present patent application should not be granted a patent under the provision of 2nd par. of Art. 29 of the Patent Law since it could have easily been made by persons skilled in the art on the basis of Publication 1 or Publication 2 or by a combination of Publication 1 or Publication 2 and Publications 3 to 5.

(2) The invention related to claim 23, claim 25, and claim 26 of the present patent application should not be granted a patent under the provision of Sec. 2, 6th par. of Art. 36 of the Patent Law since the invention for which a patent is sought is not made clear in the descriptions stated in claim 23, claim 25, and claim 26.

2. The inventions related to the present patent application

The invention related to claims 1 to 38 of the present patent application has the following components:

[Claim 1]

An ignition device comprising:

an ignition plug including

(A) a mounting fixture (10) that can be attached to an internal combustion engine;

(B) a center electrode (30) that is insulated and held within the mounting fixture of which one end section (31), which is cylindrical, is exposed from one end section (11) of the mounting fixture and extended; and

(C) a grounded electrode (40) that extends so that one end side is joined to the one end section of the mounting fixture and one surface of the other end side (43) faces the one end section of the center electrode,

wherein,

(D) a cylindrical protruding section (41) that extends to the center electrode side so as to face the one end side of the center electrode is formed on one surface of the grounded electrode facing the center electrode;

(E) an opposing space between the one end section of the center electrode and the protruding section of the grounded electrode is formed as a discharge gap (50);

(F) diameters of the one end section of the center electrode and the protruding section of the grounded electrode are both equal to or less than 2.3mm; and

(G) ignition energy supplied to the ignition plug is less than 17mJ.

[Claim 2]

An ignition device comprising:

an ignition plug including

(H) a mounting fixture that can be attached to an internal combustion engine (10);

(I) a center electrode (30) that is insulated and held within the mounting fixture of which one end section (31), which is cylindrical, is exposed from one end section (11) of the mounting fixture and extended; and

(J) a grounded electrode (40) that extends so that one end side is joined to the one end section of the mounting fixture and one surface of the other end side (43) faces the one end section of the center electrode;

wherein,

(K) a cylindrical protruding section (41) that extends to the center electrode side so as to face the one end section of the center electrode is formed on the one surface of the grounded electrode facing the center electrode;

(L) an opposing space between the one end section of the center electrode and the protruding section of the grounded electrode is formed as a discharge gap (50);

(M) diameters of one end section of the center electrode and the protruding section of the grounded electrode are both equal to or less than 2.3mm; and

(N) ignition energy density of ignition energy supplied to the ignition plug is less than 32W.

[Claim 3]

The ignition device according to claim 1 or 2, wherein:

(O) the discharge gap (50) is equal to or less than 0.7mm.

[Claim 4]

The ignition device according to any one of claims 1 to 3, wherein:

(P) a screw section (12) that connects to the internal combustion engine using a screw is formed on an outer peripheral surface of the mounting fixture (11) and has a screw diameter equal to or less than M12.

[Claim 5]

The ignition device according to any one of claims 1 to 4, wherein:

(Q) a protrusion length (L) of the protruding section in the grounded electrode is equal to or more than 0.3mm.

[Claim 6]

The ignition device according to claim 5, wherein:

(R) the protrusion length (L) is equal to or less than 1.5mm.

[Claim 7]

The ignition device according to any one of claims 1 to 6, wherein:

(S) the diameters of the one end section (31) of the center electrode (30) and the protruding section (41) of the grounded electrode (40) are both equal to or less than

1.1mm.

[Claim 8]

The ignition device according to any one of claims 1 to 7, comprising:

(T) an ignition power supply (60) that applies a voltage between the center electrode (30) and the grounded electrode (40) in the ignition plug.

[Claim 9]

The ignition device according to any one of claims 1 to 7, comprising:

(U) an ignition power supply (60) having an ignition coil that applies a voltage between the center electrode (30) and the grounded electrode (40) in the ignition plug;

wherein,

(V) a diameter of the ignition coil is equal to or less than ϕ22mm.

[Claim 10]

The ignition device according to any one of claims 1 to 7, comprising:

(W) an ignition power supply (60) that applies a voltage between the center electrode and the grounded electrode;

wherein,

(X) the protruding section in the grounded electrode is formed from platinum alloy or iridium alloy; and

(Y) the ignition power supply applies a positive voltage to the center electrode during discharge.

[Claim 11]

The ignition device according to any one of claims 8 to 10, wherein:

(Z) the diameters of the one end section (31) of the center electrode (30) and the protruding section (41) of the grounded electrode (40) are both equal to or less than 1.1mm.

[Claim 12]

An ignition device comprising:

an ignition plug including

(AA) a mounting fixture that can be attached to an internal combustion engine (10);

(AB) a center electrode (30) that is insulated and held within the mounting fixture of which one end section (31), which is cylindrical, is exposed from one end section (11) of the mounting fixture and extended; and

(AC) a grounded electrode (40) that extends so that one end side is joined to the one end section of the mounting fixture and one surface of the other end side (43) faces the one end section of the center electrode,

wherein,

(AD) a cylindrical protruding section (41) that extends to the center electrode side so as to face the one end section of the center electrode is formed on the one surface of the grounded electrode facing the center electrode;

(AE) an opposing space between the one end section of the center electrode and the protruding section of the grounded electrode is formed as a discharge gap (50);

(AF) cross-sectional areas of all cross-sections in a direction perpendicular to an axis in both the one end section of the center electrode and the protruding section of the

grounded electrode are equal to or less than 4.2mm^2; and

(AG) ignition energy supplied to the ignition plug is less than 17mJ.

[Claim 13]

An ignition device comprising:

an ignition plug including

(AH) a mounting fixture that can be attached to an internal combustion engine (10);

(AI) a center electrode (30) that is insulated and held within the mounting fixture of which one end section (31), which is cylindrical, is exposed from one end section (11) of the mounting fixture and extended; and

(AJ) a grounded electrode (40) that extends so that one end side is joined to the one end section of the mounting fixture and one surface of the other end side (43) faces the one end section of the center electrode,

wherein,

(AK) a cylindrical protruding section (41) that extends to the center electrode side so as to face the one end section of the center electrode is formed on the one surface of the grounded electrode facing the center electrode;

(AL) an opposing space between the one end section of the center electrode and the protruding section of the grounded electrode is formed as a discharge gap (50);

(AM) cross-sectional areas of all cross-sections in a direction perpendicular to an axis in both the one end section of the center electrode and the protruding section of the grounded electrode are equal to or less than 4.2mm^2; and

(AN) ignition energy density of ignition energy supplied to the ignition plug is less than 32W.

[Claim 14]

The ignition device according to claim 12 or 13, wherein:

(AO) the discharge gap (50) is equal to or less than 0.7mm.

[Claim 15]

The ignition device according to any one of claims 12 to 14, wherein:

(AP) a screw section (12) that connects to the internal combustion engine using a screw is formed on an outer peripheral surface of the mounting fixture (11) and has a screw diameter equal to or less than M12.

[Claim 16]

The ignition device according to any one of claims 12 to 15, wherein:

(AQ) a protrusion length (L) of the protruding section in the grounded electrode is equal to or more than 0.3mm.

[Claim 17]

The ignition device according to claim 16, wherein:

(AR) the protrusion length (L) is equal to or less than 1.5mm.

[Claim 18]

The ignition device according to any one of claims 12 to 17, wherein:

(AS) the cross-sectional areas of all cross-sections in the direction perpendicular to the axis in both the one end section (31) of the center electrode (30) and the protruding section (41) of the grounded electrode (40) are equal to or less than 1mm^2.

[Claim 19]
The ignition device according to any one of claims 12 to 18, comprising:

(AT) an ignition power supply (60) that applies a voltage between the center electrode (30) and the grounded electrode (40) in the ignition plug.

[Claim 20]
The ignition device according to any one of claims 12 to 18, comprising:

(AU) an ignition power supply (60) having an ignition coil that applies a voltage between the center electrode (30) and the grounded electrode (40) in the ignition plug,

wherein,

(AV) a diameter of the ignition coil is equal to or less than ϕ22mm.

[Claim 21]
The ignition device according to any one of claims 12 to 18, comprising:

(AW) an ignition power supply (60) that applies a voltage between the center electrode and the grounded electrode;

wherein,

(AX) the protruding section in the grounded electrode is formed from platinum alloy or iridium alloy; and

(AY) the ignition power supply applies a positive voltage to the center electrode during discharge.

[Claim 22]
The ignition device according to any one of claims 19 to 21, wherein:

(AZ) the cross-sectional areas of all cross-sections in the direction perpendicular to the axis in both the one end section (31) of the center electrode (30) and the protruding section (41) of the grounded electrode (40) are equal to or less than 1mm^2.

[Claim 23]
An ignition device comprising:

an ignition plug to which ignition energy E(mJ) is applied that carries out ignition between the center electrode and the grounded electrode and includes

(BA) a mounting fixture that can be attached to an internal combustion engine (10);

(BB) a center electrode (30) that is insulated and held within the mounting fixture of which one end section (31), which is cylindrical, is exposed from one end section (11) of the mounting fixture and extended; and

(BC) a grounded electrode (40) that extends so that one end side is joined to the one end section of the mounting fixture and one surface of the other end side (43) faces the one end section of the center electrode,

wherein,

(BD) a cylindrical protruding section (41) that extends to the center electrode side so as to face the one end section of the center electrode is formed on the one surface of the grounded electrode facing the center electrode;

(BE) a diameter ϕD(mm) of the protruding section is equal to or more than 0.4mm and equal to or less than 2.3mm; and

(BF) a length h(mm) of the protruding section has a following relationship with the ignition energy E(mJ) supplied to the ignition plug:

$0.3(mm) \leq h \leq 0.016E^2-0.56E+5.2(mm)$

$(8.5(mJ) \leq E \leq 17(mJ))$

[Claim 24]

The ignition device according to claim 23, wherein:

(BG) cross-sectional areas of the one end section of the center electrode and the protruding section of the grounded electrode are both equal to or less than $4.2mm^2$;

(BH) ignition energy density of ignition energy supplied to the ignition plug is less than 32W.

[Claim 25]

The ignition device according to claim 23, wherein:

(BI) diameter D1 of the one end section of the center electrode and diameter D2 of the protruding section of the grounded electrode are both equal to or less than ϕ2.3mm; and

(BJ) the diameter D1 of the one end section of the center electrode and the diameter D2 of the protruding section of the grounded electrode have a following relationship with the ignition energy E(mJ):

$1.5D2^2+0.1D2+8(mJ) \leq E < 0.34D1^2+0.2D1+16.4(mJ)$.

[Claim 26]

The ignition device according to claim 23, wherein:

(BK) diameter D1 of the one end section of the center electrode and diameter D2 of the protruding section of the grounded electrode are both equal to or less than ϕ2.3mm; and

(BL) the diameter D1 of the one end section of the center electrode and the diameter D2 of the protruding section of the grounded electrode have a following relationship with ignition energy density Q(W):

$3D2^2+0.2D2^2+16(W) \leq Q < 0.68D1^2+0.4D1+32.8(W)$.

[Claim 27]

The ignition device according to claim 24, wherein:

(BM) diameter D1 of the one end section of the center electrode and diameter D2 of the protruding section of the grounded electrode are both equal to or less than ϕ2.3mm; and

(BN) a discharge gap formed between the one end section and the protruding section is equal to or less than 0.7mm.

[Claim 28]

The ignition device according to claim 25, wherein

(BO) a screw section (12) that connects to the internal combustion engine using a screw is formed on an outer peripheral surface of the mounting fixture (11) and has a screw diameter equal to or less than M12.

[Claim 29]

The ignition device according to claim 28, wherein:

(BP) the protrusion length (L) of the grounded electrode is equal to or less than 1.5mm.

[Claim 30]

The ignition device according to claim 23, wherein:

(BQ) the protrusion length is equal to or less than 0.8mm.

[Claim 31]

The ignition device according to any one of claims 27 to 30, wherein:

(BR) the cross-sectional areas of the one end section (31) of the center electrode (30) and the protruding section (41) of the grounded electrode (40) are both equal to or less than $1mm^2$.

[Claim 32]

An ignition device comprising:

(BS) an ignition plug (S1) according to claim 27 or 28; and

(BT) an ignition power supply (60) having an ignition coil that applies a voltage between the center electrode and the grounded electrode;

wherein,

(BU) a diameter of the ignition coil is equal to or less than ϕ22mm.

[Claim 33]

The ignition device according to claim 23, comprising:

(BV) an ignition power supply (60) that applies a voltage between the center electrode and the grounded electrode;

wherein,

(BW) the ignition power supply applies a positive voltage to the center electrode during discharge.

[Claim 34]

The ignition device according to any one of claims 32 to 33, wherein:

(BX) the cross-sectional areas of the one end section (31) of the center electrode (30) and the protruding section (41) of the grounded electrode (40) are both equal to or less than $1mm^2$.

[Claim 35]

The ignition device according to any one of claims 23 to 34, wherein:

(BY) the protruding section in the grounded electrode is an alloy of which a major element is Pt, to which at least one of Ir, Ni, Rh, W, Pd, Ru, or Os is added.

[Claim 36]

The ignition device according to any one of claims 23 to 34, wherein:

(BZ) the protruding section in the grounded electrode is an alloy of which a major element is Pt, to which at least one of Ir, which is equal to or more than 0 and equal to or less than 50wt%, Ni, which is equal to or more than 0 and equal to or less than 40wt%, Rh, which is equal to or more than 0 and equal to or less than 50wt%, W, which is equal to or more than 0 and equal to or less than 30wt%, Pd, which is equal to or more than 0 and equal to or less than 40wt%, Ru, which is equal to or more than 0 and equal to or less than 30wt%, or Os, which is equal to or more than 0 and equal to or less than 20wt%, is added.

[Claim 37]

The ignition device according to any one of claims 23 to 34, wherein:

(CA) the protruding section in the grounded electrode is an alloy of which a major element is Ir to which at least one of Rh, Pt, Ni, W, Pd, Ru, or Os is added.

[Claim 38]

The ignition device according to any one of claims 23 to 34, wherein:

(CB) the protruding section in the grounded electrode is an alloy of which a major element is Ir to which at least one of Rh, which is equal to or more than 0 and equal to or less than 50wt%, Pt, which is equal to or more than 0 and equal to or less than 50wt%, Ni, which is equal to or more than 0 and equal to or less than 40wt%, W, which is equal to or more than 0 and equal to or less than 30wt%, Pd, which is equal to or more than 0 and equal to or less than 40wt%, Ru, which is equal to or more than 0 and equal to or less than 30wt%, or Os, which is equal to or more than 0 and equal to or less than 20wt%, is added.

3. Regarding Breach of Art. 36

(1) Regarding Claim 23

i) The component BF in claim 23 of the present patent application specifies that "a length h(mm) of the protruding section has a following relationship with the ignition energy E(mJ) supplied to the ignition plug: $0.3(mm) \leq h \leq 0.016E^2-0.56E+5.2(mm)(8.5(mJ) \leq E \leq 17(mJ))$."

ii) However, in the above-described relational expression, regardless of E expressing the ignition energy (unit: mJ), the unit for "$0.016E^2-0.56E+5.2$" is a unit of length (mm). As a result, the above-described relational expression is technically ambiguous.

iii) Therefore, in the description in claim 23 of the present patent application, the invention for which a patent is sought is unclear.

(2) Regarding Claim 25

i) The component BJ in claim 26 pf the present patent application specifies that "...have a following relationship with the ignition energy E(mJ): $1.5D2^2+0.1D2+8(mJ) \leq E < 0.34D1^2+0.2D1+16.4(mJ)$."

ii) However, in the above-described relational expression, regardless of D1 and D2 expressing the diameters (unit: mm), the unit for "$1.5D2^2+0.1D2+8$" and "$0.34D1^2+0.2D1+16.4$" is a unit of energy (mJ). As a result, the above-described relational expression is technically ambiguous.

iii) Therefore, in the description in claim 25 of the present patent application, the invention for which a patent is sought is unclear.

(3) Regarding Claim 26

i) The component BL in claim 26 of the present patent application specifies that "...have a following relationship with ignition energy density Q(W): $3D2^2+0.2D2^2+16(W) \leq Q < 0.68D1^2+0.4D1+32.8(W)$."

ii) However, in the above-described relational expression, regardless of D1 and D2 expressing the diameters (unit: mm), the unit for "$3D2^2+0.2D2^2+16$" and "$0.68D1^2+0.4D1+32.8$" is a unit of energy density (W). As a result, the above-described relational expression is technically ambiguous.

iii) Therefore, in the description in claim 26 of the present patent application, the invention for which a patent is sought is unclear.

4. Explanation of Evidence
(1) Overview of Explanation of Evidence

Present Patent Application (Patent Application No. 2002-23520 and Publication No. 2002-319469)
Date of Application: January 31, 2002
Date of International Filing: February 13, 2001
Claim
Scope of Claims

Publication 1
JP-A-2000-100545
Date of Publication: April 7, 2000

Publication 2
JP-A-H9-219274
Date of Publication: August 19, 1997

Publication 3
JP-A-H4-209968
Date of Publication: July 31, 1992

Publication 4
JP-A-2000-223239
Date of Publication: August 11, 2000

Publication 5
JP-A-2000-228322
Date of Publication: August 15, 2000

(Claim 1)
(A)
a mounting fixture (10) that can be attached to an internal combustion engine;
(Publication 1)
[FIG. 1] a main metal fitting 1
(Publication 2)
[FIG. 1] a fitting piece 1

(B)
a center electrode (30) that is insulated and held within the mounting fixture of which one end section (31), which is cylindrical, is exposed from one end section (11) of the mounting fixture and extended; and
(Publication 1)
[FIG. 1] a center electrode 3

(Publication 2)
[FIG. 1] a center electrode 3

(C)
a grounded electrode (40) that extends so that one end side is joined to the one end section of the mounting fixture and one surface of the other end side (43) faces the one end section of the center electrode,
(Publication 1)
[FIG. 1] a grounded electrode 4
(Publication 2)
[FIG. 1] a grounded electrode 4

(D)
wherein, a cylindrical protruding section (41) that extends to the center electrode side so as to face the one end side of the center electrode is formed on one surface of the grounded electrode facing the center electrode;
(Publication 1)
[FIG. 2] a spark portion 32
(Publication 2)
[FIG. 2] a noble metal tip 52

(E)
an opposing space between the one end section of the center electrode and the protruding section of the grounded electrode is formed as a discharge gap (50);
(Publication 1)
[FIG. 1] a spark discharge gap g
(Publication 2)
[FIG. 1] a discharge gap 6

(F)
diameters of the one end section of the center electrode and the protruding section of the grounded electrode are both equal to or less than 2.3mm; and
(Publication 1)
[0033] the spark portion 31 and the spark portion 32 are... processed into a tip that is a circular plate having a diameter of 0.2mm to 1.6mm....
(Publication 2)
[0042] the noble metal tips 51 of which the respective end diameters G are 0.6mm, 0.9mm, and 1.2mm
[0028] The noble metal tip 52 is... The tip diameter is 0.9mm

(G)
ignition energy supplied to the ignition plug is less than 17mJ.
(Publication 1)
×

(Publication 2)
×
(Publication 3)
[Claim 1] spark energy of 20 millijoules or less

(Claim 2)
An ignition device comprising:
an ignition plug including
(H)
a mounting fixture that can be attached to an internal combustion engine (10);
(Publication 1)
[FIG. 1] a main metal fitting 1
(Publication 2)
[FIG. 1] a fitting piece 1

(I)
a center electrode (30) that is insulated and held within the mounting fixture of which one end section (31), which is cylindrical, is exposed from one end section (11) of the mounting fixture and extended; and
(Publication 1)
[FIG. 1] a center electrode 3
(Publication 2)
[FIG. 1] a center electrode 3

(J)
a grounded electrode (40) that extends so that one end side is joined to the one end section of the mounting fixture and one surface of the other end side (43) faces the one end section of the center electrode;
(Publication 1)
[FIG. 1] a grounded electrode 4
(Publication 2)
[FIG. 1] a grounded electrode 4

(K)
wherein, a cylindrical protruding section (41) that extends to the center electrode side so as to face the one end section of the center electrode is formed on the one surface of the grounded electrode facing the center electrode;
(Publication 1)
[FIG. 2] a spark portion 32
(Publication 2)
[FIG. 2] a noble metal tip 52

(L)
an opposing space between the one end section of the center electrode and the protruding

section of the grounded electrode is formed as a discharge gap (50);
(Publication 1)
[FIG. 1] a spark discharge gap g
(Publication 2)
[FIG. 1] a discharge gap 6

(M)
diameters of one end section of the center electrode and the protruding section of the grounded electrode are both equal to or less than 2.3mm; and
(Publication 1)
[0033] the spark portion 31 and the spark portion 32 are... processed into a tip that is a circular plate having a diameter of 0.2mm to 1.6mm....
(Publication 2)
[0042] the noble metal tips 51 of which the respective end diameters G are 0.6mm, 0.9mm, and 1.2mm
(Publication 2)
[0028] The noble metal tip 52 is... The tip diameter is 0.9mm

(N)
ignition energy density of ignition energy supplied to the ignition plug is less than 32W.
(Publication 1)
×
(Publication 2)
×
(Publication 3)
[Claim 1] a duration time of an induction component of a spark discharge is 1.0msec or less and 0.2msec or more with spark energy of 20 millijoules or less; energy density 5W to 100W

(Claim 3)
The ignition device according to claim 1 or 2, wherein:
(O)
the discharge gap (50) is equal to or less than 0.7mm.
(Publication 1)
[0033] a width γ of the spark discharge gap g is set to be no more than 1.2mm, preferably 0.3mm to 1.1mm,
(Publication 2)
[0042] the discharge gap A is... 0.7mm, 0.9mm, and 1.1mm.

(Claim 4)
The ignition device according to any one of claims 1 to 3, wherein:
(P)
a screw section (12) that connects to the internal combustion engine using a screw is formed on an outer peripheral surface of the mounting fixture (11) and has a screw

diameter equal to or less than M12.
(Publication 1)
×
(Publication 2)
[0022] an outer diameter D of the plug screw 1a is 12mm or less.

(Claim 5)
The ignition device according to any one of claims 1 to 4, wherein:
(Q)
a protrusion length (L) of the protruding section in the grounded electrode is equal to or more than 0.3mm.
(Publication 1)
[0033] the spark portion 31 and the spark portion 32 are... processed into a tip that is a circular plate having... a thickness of 0.6mm.
(Publication 2)
[0028] The noble metal tip 52 is... the height is 0.3mm.

(Claim 6)
The ignition device according to claim 5, wherein:
(R)
the protrusion length (L) is equal to or less than 1.5mm.
(Publication 1)
[0033] the spark portion 31 and the spark portion 32 are... processed into a tip that is a circular plate having... a thickness of 0.6mm.
(Publication 2)
[0028] The noble metal tip 52 is... the height is 0.3mm.

(Claim 7)
The ignition device according to any one of claims 1 to 6, wherein:
(S)
the diameters of the one end section (31) of the center electrode (30) and the protruding section (41) of the grounded electrode (40) are both equal to or less than 1.1mm.
(Publication 1)
[0033] the spark portion 31 and the spark portion 32 are... processed into a tip that is a circular plate having a diameter of 0.2mm to 1.6mm....
(Publication 2)
[0042] the noble metal tips 51 of which the respective end diameters G are 0.6mm, 0.9mm, and 1.2mm,
[0028] The noble metal tip 52 is... The tip diameter is 0.9mm....

(Claim 8)
The ignition device according to any one of claims 1 to 7, comprising:
(T)
an ignition power supply (60) that applies a voltage between the center electrode (30) and

the grounded electrode (40) in the ignition plug.
(Publication 1)
[FIG. 3] an ignition system 150
(Publication 2)
×

(Claim 9)
The ignition device according to any one of claims 1 to 7, comprising:
(U)
an ignition power supply (60) having an ignition coil that applies a voltage between the center electrode (30) and the grounded electrode (40) in the ignition plug;
(Publication 1)
[FIG. 3] ignition coils 51, an ignition system 150
(Publication 2)
×

(V)
wherein, a diameter of the ignition coil is equal to or less than ϕ22mm.
(Publication 1)
×
(Publication 2)
×
(Publication 5)
[0045] the outer diameter of the coil to be inserted is about ϕ18 to ϕ27mm, including the side core.

(Claim 10)
The ignition device according to any one of claims 1 to 7, comprising:
(W)
an ignition power supply (60) that applies a voltage between the center electrode and the grounded electrode;
(Publication 1)
[FIG. 3] an ignition system 150
(Publication 2)
×

(X)
wherein, the protruding section in the grounded electrode is formed from platinum alloy or iridium alloy; and
(Publication 1)
[0033] the spark portion 31 and the spark portion 32... a metal alloy of which 5w% is Pt and the remaining weight percent is Ir is prepared... the metal alloy is processed into a tip....
(Publication 2)

[0028] The noble metal tip 52 is formed from Pt alloy (Pt-20Ir-2Ni).

(Y)
the ignition power supply applies a positive voltage to the center electrode during discharge.
(Publication 1)
×
(Publication 2)
×
(Publication 4)
[0050] a positive polarity ignition system

(Claim 11)
The ignition device according to any one of claims 8 to 10, wherein:
(Z)
the diameters of the one end section (31) of the center electrode (30) and the protruding section (41) of the grounded electrode (40) are both equal to or less than 1.1mm.
(Publication 1)
[0033] the spark portion 31 and the spark portion 32 are... processed into a tip that is a circular plate having a diameter of 0.2mm to 1.6mm....
(Publication 2)
[0042] the noble metal tips 51 of which the respective end diameters G are 0.6mm, 0.9mm, and 1.2mm
[0028] The noble metal tip 52 is... The tip diameter is 0.9mm

(Claim 12)
An ignition device comprising:
an ignition plug including
(AA)
a mounting fixture that can be attached to an internal combustion engine (10);
(Publication 1)
[FIG. 1] a main metal fitting 1
(Publication 2)
[FIG. 1] a fitting piece 1

(AB)
a center electrode (30) that is insulated and held within the mounting fixture of which one end section (31), which is cylindrical, is exposed from one end section (11) of the mounting fixture and extended; and
(Publication 1)
[FIG. 1] a center electrode 3
(Publication 2)
[FIG. 1] a center electrode 3

(AC)
a grounded electrode (40) that extends so that one end side is joined to the one end section of the mounting fixture and one surface of the other end side (43) faces the one end section of the center electrode,
(Publication 1)
[FIG. 1] a grounded electrode 4
(Publication 2)
[FIG. 1] a grounded electrode 4

(AD)
wherein, a cylindrical protruding section (41) that extends to the center electrode side so as to face the one end section of the center electrode is formed on the one surface of the grounded electrode facing the center electrode;
(Publication 1)
[FIG. 2] a spark portion 32
(Publication 2)
[FIG. 2] a noble metal tip 52

(AE)
an opposing space between the one end section of the center electrode and the protruding section of the grounded electrode is formed as a discharge gap (50);
(Publication 1)
[FIG. 1] a spark discharge gap g
(Publication 2)
[FIG. 1] a discharge gap 6

(AF)
cross-sectional areas of all cross-sections in a direction perpendicular to an axis in both the one end section of the center electrode and the protruding section of the grounded electrode are equal to or less than 4.2mm^2; and
(Publication 1)
[0033] the spark portion 31 and the spark portion 32 are... processed into a tip that is a circular plate having a diameter of 0.2mm to 1.6mm....
(Publication 2)
[0042] the noble metal tips 51 of which the respective end diameters G are 0.6mm, 0.9mm, and 1.2mm
[0028] The noble metal tip 52 is... The tip diameter is 0.9mm

(AG)
ignition energy supplied to the ignition plug is less than 17mJ.
(Publication 1)
×
(Publication 2)
×

(Publication 3)
[Claim 1] spark energy of 20 millijoules or less

(Claim 13)
An ignition device comprising:
an ignition plug including
(AH)
a mounting fixture that can be attached to an internal combustion engine (10);
(Publication 1)
[FIG. 1] a main metal fitting 1
(Publication 2)
[FIG. 1] a fitting piece 1

(AI)
a center electrode (30) that is insulated and held within the mounting fixture of which one end section (31), which is cylindrical, is exposed from one end section (11) of the mounting fixture and extended; and
(Publication 1)
[FIG. 1] a center electrode 3
(Publication 2)
[FIG. 1] a center electrode 3

(AJ)
a grounded electrode (40) that extends so that one end side is joined to the one end section of the mounting fixture and one surface of the other end side (43) faces the one end section of the center electrode,
(Publication 1)
[FIG. 1] a grounded electrode 4
(Publication 2)
[FIG. 1] a grounded electrode 4

(AK)
wherein, a cylindrical protruding section (41) that extends to the center electrode side so as to face the one end section of the center electrode is formed on the one surface of the grounded electrode facing the center electrode;
(Publication 1)
[FIG. 2] a spark portion 32
(Publication 2)
[FIG. 2] a noble metal tip 52

(AL)
an opposing space between the one end section of the center electrode and the protruding section of the grounded electrode is formed as a discharge gap (50);
(Publication 1)

[FIG. 1] a spark discharge gap g
(Publication 2)
[FIG. 1] a discharge gap 6

(AM)
cross-sectional areas of all cross-sections in a direction perpendicular to an axis in both the one end section of the center electrode and the protruding section of the grounded electrode are equal to or less than 4.2mm^2; and
(Publication 1)
[0033] the spark portion 31 and the spark portion 32 are... processed into a tip that is a circular plate having a diameter of 0.2mm to 1.6mm....
(Publication 2)
[0042] the noble metal tips 51 of which the respective end diameters G are 0.6mm, 0.9mm, and 1.2mm
[0028] The noble metal tip 52 is... The tip diameter is 0.9mm

(AN)
ignition energy density of ignition energy supplied to the ignition plug is less than 32W.
(Publication 1)
×
(Publication 2)
×
(Publication 3)
[Claim 1] a duration time of an induction component of a spark discharge is 1.0msec or less and 0.2msec or more with spark energy of 20 millijoules or less; energy density 5W to 100W

(Claim 14)
The ignition device according to claim 12 or 13, wherein:
(AO)
the discharge gap (50) is equal to or less than 0.7mm.
(Publication 1)
[0033] a width γ of the spark discharge gap g is set to be no more than 1.2mm, preferably 0.3mm to 1.1mm,
(Publication 2)
[0042] the discharge gap A is... 0.7mm, 0.9mm, and 1.1mm.

(Claim 15)
The ignition device according to any one of claims 12 to 14, wherein:
(AP)
a screw section (12) that connects to the internal combustion engine using a screw is formed on an outer peripheral surface of the mounting fixture (11) and has a screw diameter equal to or less than M12.
(Publication 1)

×
(Publication 2)
[0022] an outer diameter D of the plug screw 1a is 12mm or less.

(Claim 16)
The ignition device according to any one of claims 12 to 15, wherein:
(AQ)
a protrusion length (L) of the protruding section in the grounded electrode is equal to or more than 0.3mm.
(Publication 1)
[0033] the spark portion 31 and the spark portion 32 are... processed into a tip that is a circular plate having... a thickness of 0.6mm.
(Publication 2)
[0028] The noble metal tip 52 is... the height is 0.3mm.

(Claim 17)
The ignition device according to claim 16, wherein:
(AR)
the protrusion length (L) is equal to or less than 1.5mm.
(Publication 1)
[0033] the spark portion 31 and the spark portion 32 are... processed into a tip that is a circular plate having... a thickness of 0.6mm.
(Publication 2)
[0028] The noble metal tip 52 is... the height is 0.3mm.

(Claim 18)
The ignition device according to any one of claims 12 to 17, wherein:
(AS)
the cross-sectional areas of all cross-sections in the direction perpendicular to the axis in both the one end section (31) of the center electrode (30) and the protruding section (41) of the grounded electrode (40) are equal to or less than $1mm^2$.
(Publication 1)
[0033] the spark portion 31 and the spark portion 32 are... processed into a tip that is a circular plate having a diameter of 0.2mm to 1.6mm....
(Publication 2)
[0042] the noble metal tips 51 of which the respective end diameters G are 0.6mm, 0.9mm, and 1.2mm
[0028] The noble metal tip 52 is... The tip diameter is 0.9mm

(Claim 19)
The ignition device according to any one of claims 12 to 18, comprising:
(AT)
an ignition power supply (60) that applies a voltage between the center electrode (30) and the grounded electrode (40) in the ignition plug.

(Publication 1)
[FIG. 3] an ignition system 150
(Publication 2)
×

(Claim 20)
The ignition device according to any one of claims 12 to 18, comprising:
(AU)
an ignition power supply (60) having an ignition coil that applies a voltage between the center electrode (30) and the grounded electrode (40) in the ignition plug,
(Publication 1)
[FIG. 3] ignition coils 51, an ignition system 150
(Publication 2)
×

(AV)
wherein, a diameter of the ignition coil is equal to or less than ϕ22mm.
(Publication 1)
×
(Publication 2)
×
(Publication 5)
[0045] the outer diameter of the coil to be inserted is about ϕ18 to ϕ27mm, including the side core.

(Claim 21)
The ignition device according to any one of claims 12 to 18, comprising:
(AW)
an ignition power supply (60) that applies a voltage between the center electrode and the grounded electrode;
(Publication 1)
[FIG. 3] an ignition system 150
(Publication 2)
×

(AX)
wherein, the protruding section in the grounded electrode is formed from platinum alloy or iridium alloy; and
(Publication 1)
[0033] the spark portion 31 and the spark portion 32 are... a metal alloy of which 5w% is Pt and the remaining weight percent is Ir is prepared... the metal alloy is processed into a tip....
(Publication 2)
[0028] The noble metal tip 52 is formed from Pt alloy (Pt-20Ir-2Ni).

(AY)
the ignition power supply applies a positive voltage to the center electrode during discharge.
(Publication 1)
×
(Publication 2)
×
(Publication 4)
[0050] a positive polarity ignition system

(Claim 22)
The ignition device according to any one of claims 19 to 21, wherein:
(AZ)
the cross-sectional areas of all cross-sections in the direction perpendicular to the axis in both the one end section (31) of the center electrode (30) and the protruding section (41) of the grounded electrode (40) are equal to or less than $1mm^2$.
(Publication 1)
[0033] the spark portion 31 and the spark portion 32 are... processed into a tip that is a circular plate having a diameter of 0.2mm to 1.6mm...
(Publication 2)
[0042] the noble metal tips 51 of which the respective end diameters G are 0.6mm, 0.9mm, and 1.2mm
[0028] The noble metal tip 52 is... The tip diameter is 0.9mm

(Claim 23)
An ignition device comprising:
an ignition plug to which ignition energy E(mJ) is applied that carries out ignition between the center electrode and the grounded electrode and includes
(BA)
a mounting fixture that can be attached to an internal combustion engine (10);
(Publication 1)
[FIG. 1] a main metal fitting 1
(Publication 2)
[FIG. 1] a fitting piece 1

(BB)
a center electrode (30) that is insulated and held within the mounting fixture of which one end section (31), which is cylindrical, is exposed from one end section (11) of the mounting fixture and extended; and
(Publication 1)
[FIG. 1] a center electrode 3
(Publication 2)
[FIG. 1] a center electrode 3

(BC)
a grounded electrode (40) that extends so that one end side is joined to the one end section of the mounting fixture and one surface of the other end side (43) faces the one end section of the center electrode,
(Publication 1)
[FIG. 1] a grounded electrode 4
(Publication 2)
[FIG. 1] a grounded electrode 4

(BD)
wherein, a cylindrical protruding section (41) that extends to the center electrode side so as to face the one end section of the center electrode is formed on the one surface of the grounded electrode facing the center electrode;
(Publication 1)
[FIG. 2] a spark portion 32
(Publication 2)
[FIG. 2] a noble metal tip 52

(BE)
a diameter ϕD(mm) of the protruding section is equal to or more than 0.4mm and equal to or less than 2.3mm; and
(Publication 1)
[0033] the spark portion 31 and the spark portion 32 are... processed into a tip that is a circular plate having a diameter of 0.2mm to 1.6mm....
(Publication 2)
[0028] The noble metal tip 52 is... The tip diameter is 0.9mm

(BF)
a length h(mm) of the protruding section has a following relationship with the ignition energy E(mJ) supplied to the ignition plug:
$0.3(mm) \leq h \leq 0.016E^2-0.56E+5.2(mm)$
$(8.5(mJ) \leq E \leq 17(mJ))$
(Publication 1)
×
(Publication 2)
[0028] The noble metal tip 52 is... the height is 0.3mm.
(Publication 3)
[Claim 1] spark energy of 20 millijoules or less

(Claim 24)
The ignition device according to claim 23, wherein:
(BG)
cross-sectional areas of the one end section of the center electrode and the protruding

section of the grounded electrode are both equal to or less than 4.2mm^2;
(Publication 1)
[0033] the spark portion 31 and the spark portion 32 are... processed into a tip that is a circular plate having a diameter of 0.2mm to 1.6mm....
(Publication 2)
[0042] the noble metal tips 51 of which the respective end diameters G are 0.6mm, 0.9mm, and 1.2mm
[0028] The noble metal tip 52 is... The tip diameter is 0.9mm

(BH)
ignition energy density of ignition energy supplied to the ignition plug is less than 32W.
(Publication 1)
×
(Publication 2)
×
(Publication 3)
[Claim 1] a duration time of an induction component of a spark discharge is 1.0msec or less and 0.2msec or more with spark energy of 20 millijoules or less; energy density 5W to 100W

(Claim 25)
The ignition device according to claim 23, wherein:
(BI)
diameter D1 of the one end section of the center electrode and diameter D2 of the protruding section of the grounded electrode are both equal to or less than ϕ2.3mm; and
(Publication 1)
[0033] the spark portion 31 and the spark portion 32 are... processed into a tip that is a circular plate having a diameter of 0.2mm to 1.6mm...
(Publication 2)
[0042] the noble metal tips 51 of which the respective end diameters G are 0.6mm, 0.9mm, and 1.2mm
[0028] The noble metal tip 52 is... The tip diameter is 0.9mm

(BJ)
...have a following relationship with the ignition energy E(mJ):
$1.5D2^2+0.1D2+8(mJ) \leq E < 0.34D1^2+0.2D1+16.4(mJ)$.
(Publication 1)
×
(Publication 2)
D1=0.6, D2=0.9: $9.305 \leq E < 16.6$
D1=0.9, D2=0.9: $9.305 \leq E < 16.9$
D1=1.2, D2=0.9: $9.305 \leq E < 17.1$
(Publication 3)
[Claim 1] spark energy of 20 millijoules or less

(Claim 26)
The ignition device according to claim 23, wherein:
(BK)
diameter D1 of the one end section of the center electrode and diameter D2 of the protruding section of the grounded electrode are both equal to or less than ϕ2.3mm; and
(Publication 1)
[0033] the spark portion 31 and the spark portion 32 are... processed into a tip that is a circular plate having a diameter of 0.2mm to 1.6mm...
(Publication 2)
[0042] the noble metal tips 51 of which the respective end diameters G are 0.6mm, 0.9mm, and 1.2mm
[0028] The noble metal tip 52 is... The tip diameter is 0.9mm

(BL)
...have a following relationship with ignition energy density Q(W):
$3D2^2+0.2D2^2+16(W) \leq Q < 0.68D1^2+0.4D1+32.8(W)$.
(Publication 1)
×
(Publication 2)
D1=0.6, D2=0.9: $18.6 \leq Q < 33.3$
D1=0.9, D2=0.9: $18.6 \leq Q < 33.7$
D1=1.2, D2=0.9: $18.6 \leq Q < 34.3$
(Publication 3)
[Claim 1] a duration time of an induction component of a spark discharge is 1.0msec or less and 0.2msec or more with spark energy of 20 millijoules or less; energy density 5W to 100W

(Claim 27)
The ignition device according to claim 24, wherein:
(BM)
diameter D1 of the one end section of the center electrode and diameter D2 of the protruding section of the grounded electrode are both equal to or less than ϕ2.3mm; and
(Publication 1)
[0033] the spark portion 31 and the spark portion 32 are... processed into a tip that is a circular plate having a diameter of 0.2mm to 1.6mm...
(Publication 2)
[0042] the noble metal tips 51 of which the respective end diameters G are 0.6mm, 0.9mm, and 1.2mm
[0028] The noble metal tip 52... The tip diameter is 0.9mm

(BN)
a discharge gap formed between the one end section and the protruding section is equal to or less than 0.7mm.

(Publication 1)
[0033] a width γ of the spark discharge gap g is set to be no more than 1.2mm, preferably 0.3mm to 1.1mm,
(Publication 2)
[0042] the discharge gap A is... 0.7mm, 0.9mm, and 1.1mm.

(Claim 28)
The ignition device according to claim 25, wherein:
(BO)
a screw section (12) that connects to the internal combustion engine using a screw is formed on an outer peripheral surface of the mounting fixture (11) and has a screw diameter equal to or less than M12.
(Publication 1)
×
(Publication 2)
[0022] an outer diameter D of the plug screw 1a is 12mm or less.

(Claim 29)
The ignition device according to claim 28, wherein:
(BP)
the protrusion length (L) of the grounded electrode is equal to or less than 1.5mm.
(Publication 1)
[0033] the spark portion 31 and the spark portion 32 are... processed into a tip that is a circular plate having... a thickness of 0.6mm.
(Publication 2)
[0028] The noble metal tip 52 is... the height is 0.3mm.

(Claim 30)
The ignition device according to claim 23, wherein:
(BQ)
the protrusion length is equal to or less than 0.8mm.
(Publication 1)
[0033] the spark portion 31 and the spark portion 32 are... processed into a tip that is a circular plate having... a thickness of 0.6mm.
(Publication 2)
[0028] The noble metal tip 52 is... the height is 0.3mm.

(Claim 31)
The ignition device according to any one of claims 27 to 30, wherein:
(BR)
the cross-sectional areas of the one end section (31) of the center electrode (30) and the protruding section (41) of the grounded electrode (40) are both equal to or less than $1mm^2$.
(Publication 1)
[0033] the spark portion 31 and the spark portion 32 are... processed into a tip that is a

circular plate having a diameter of 0.2mm to 1.6mm...
(Publication 2)
[0042] the noble metal tips 51 of which the respective end diameters G are 0.6mm, 0.9mm, and 1.2mm
[0028] The noble metal tip 52 is... The tip diameter is 0.9mm

(Claim 32)
An ignition device comprising:
(BS)
an ignition plug (S1) according to claim 27 or 28; and
(Publication 1)
[FIG. 1] a spark plug 100
(Publication 2)
[FIG. 1]

(BT)
an ignition power supply (60) having an ignition coil that applies a voltage between the center electrode and the grounded electrode;
(Publication 1)
[FIG. 3] ignition coils 51, an ignition system 150
(Publication 2)
×

(BU)
wherein, a diameter of the ignition coil is equal to or less than ϕ22mm.
(Publication 1)
×
(Publication 2)
×
(Publication 5)
[0045] the outer diameter of the coil to be inserted is about ϕ18 to ϕ27mm, including the side core.

(Claim 33)
The ignition device according to claim 23, comprising:
(BV)
an ignition power supply (60) that applies a voltage between the center electrode and the grounded electrode;
(Publication 1)
[FIG. 3] an ignition system 150
(Publication 2)
×

(BW)

wherein, the ignition power supply applies a positive voltage to the center electrode during discharge.
(Publication 1)
×
(Publication 2)
×
(Publication 4)
[0050] a positive polarity ignition system

(Claim 34)
The ignition device according to any one of claims 32 to 33, wherein:
(BX)
the cross-sectional areas of the one end section (31) of the center electrode (30) and the protruding section (41) of the grounded electrode (40) are both equal to or less than $1mm^2$.
(Publication 1)
[0033] the spark portion 31 and the spark portion 32 are... processed into a tip that is a circular plate having a diameter of 0.2mm to 1.6mm...
(Publication 2)
[0042] the noble metal tips 51 of which the respective end diameters G are 0.6mm, 0.9mm, and 1.2mm
[0028] The noble metal tip 52 is... The tip diameter is 0.9mm

(Claim 35)
The ignition device according to any one of claims 23 to 34, wherein:
(BY)
the protruding section in the grounded electrode is an alloy of which a major element is Pt, to which at least one of Ir, Ni, Rh, W, Pd, Ru, or Os is added.
(Publication 1)
×
(Publication 2)
[0028] The noble metal tip 52 is formed from Pt alloy (Pt-20Ir-2Ni).

(Claim 36)
The ignition device according to any one of claims 23 to 34, wherein:
(BZ)
the protruding section in the grounded electrode is an alloy of which a major element is Pt, to which at least one of Ir, which is equal to or more than 0 and equal to or less than 50wt%, Ni, which is equal to or more than 0 and equal to or less than 40wt%, Rh, which is equal to or more than 0 and equal to or less than 50wt%, W, which is equal to or more than 0 and equal to or less than 30wt%, Pd, which is equal to or more than 0 and equal to or less than 40wt%, Ru, which is equal to or more than 0 and equal to or less than 30wt%, or Os, which is equal to or more than 0 and equal to or less than 20wt%, is added.
(Publication 1)
×

(Publication 2)
[0028] The noble metal tip 52 is formed from Pt alloy (Pt-20Ir-2Ni).

(Claim 37)
The ignition device according to any one of claims 23 to 34, wherein:
(CA)
the protruding section in the grounded electrode is an alloy of which a major element is Ir to which at least one of Rh, Pt, Ni, W, Pd, Ru, or Os is added.
(Publication 1)
[0033] the spark portion 31 and the spark portion 32... a metal alloy of which 5w% is Pt and the remaining weight percent is Ir is prepared... the metal alloy is processed into a tip....
(Publication 2)
×

(Claim 38)
The ignition device according to any one of claims 23 to 34, wherein:
(CB)
the protruding section in the grounded electrode is an alloy of which a major element is Ir to which at least one of Rh, which is equal to or more than 0 and equal to or less than 50wt%, Pt, which is equal to or more than 0 and equal to or less than 50wt%, Ni, which is equal to or more than 0 and equal to or less than 40wt%, W, which is equal to or more than 0 and equal to or less than 30wt%, Pd, which is equal to or more than 0 and equal to or less than 40wt%, Ru, which is equal to or more than 0 and equal to or less than 30wt%, or Os, which is equal to or more than 0 and equal to or less than 20wt%, is added.
(Publication 1)
[0033] the spark portion 31 and the spark portion 32... a metal alloy of which 5w% is Pt and the remaining weight percent is Ir is prepared... the metal alloy is processed into a tip....
(Publication 2)
×

(2) Explanation of Publication 1 (JP-A-2000-100545)

Paragraph [0015] of Publication 1 states that "A spark plug with resistor 100, shown in FIG. 1, is an example of the present invention. The spark plug with resistor 100 includes a cylindrical main metal fitting 1, an insulator 2, a center electrode 3, a grounded electrode 4, and the like. The insulator 2 is fitted into the main metal fitting 1 so that a tip section is protruding. The center electrode 3 is provided within the insulator 2 so that a tip section is protruding. The grounded electrode 4 is disposed so that one end is joined with the main metal fitting 1 and the other end side faces the tip of the center electrode 3. In addition, as shown in FIG. 2, a spark portion 32 facing a spark portion 31 of the center electrode is formed in the grounded electrode 4. A space between the spark portion 31 and the opposing spark portion 32 is a spark discharge gap g."

Furthermore, paragraph [0023] of Publication 1 states that "the spark portion 31, namely a tip diameter δ of the center electrode 3, is set to be no more than 1.1mm and preferably 0.3mm to 0.8mm. In addition, a width γ of the spark discharge gap g is set to be no more than 1.2mm, preferably 0.3mm to 1.1mm, and more preferably 0.6mm to 0.9mm."

Still further, paragraph [0028] of Publication 1 states that "FIG. 3 shows an example of an ignition system using the spark plug 100. An ignition system 150 is configured so that individual ignition coils 51 directly apply a voltage to each spark plug 100, without the use of a distributor. In each ignition coil 51, a primary coil 52 that receives power from a battery 156, via an ignition switch 157, is connected to an igniter 154. Another secondary coil 53 is connected to respective spark plugs 100."

Still further, paragraph [0033] of Publication 1 states that "the spark portion 31 and the spark portion 32 are formed as follows. First, a metal alloy of which 5w% is Pt and the remaining weight percent is Ir is prepared by predetermined amounts of Ir and Pt being combined and melted. Then, the metal alloy is processed into a tip that is a circular plate having a diameter of 0.2mm to 1.6mm and a thickness of 0.6mm. The spark portion 31 and the opposing spark portion 32 of the spark plug 100, shown in FIG. 1 and FIG. 2, are formed using the tip (in other words, the size of the spark portion of the center electrode 3 is adjusted to various values between 0.2mm and 1.6mm)."

In this way, Publication 1 describes the components A, B, C, D, E, F, H, I, J, K, L, M, O, Q, R, S, T, U, W, X, Z, AA, AB, AC, AD, AE, AF, AH, AI, AJ, AK, AL, AM, AO, AQ, AR, AS, AT, AU, AW, AX, AZ, BA, BB, BC, BD, BE, BG, BI, BK, BM, BN, BP, BQ, BR, BS, BT, BV, BX, CA, and CB of the present patent application.

(3) Explanation of Publication 2 (JP-A-H9-219274)

[Claim 1] in the [Scope of Claims] of Publication 2 describes "A spark plug comprising: a center electrode (3) formed from an Ni-alloy; an insulator (2) covering the periphery of the center electrode (3) so that an end (3a) of the center electrode (3) is exposed; a fitting piece (1) that is disposed so that an end (2b) of the insulator (2) is exposed and so as to surround the outer peripheral surface of the insulator (2) separated by a gas volume (7), and includes a plug screw (1a) on the outer peripheral surface; a noble metal tip (51) that is provided at the end (3a) of the center electrode (3) and formed from either one of Ir and Ir alloy; and a grounded electrode (4) that is fixed to the fitting piece (1) and faces the metal tip (51) separated by a discharge gap (6)."

Furthermore, paragraph [0022] of Publication 2 states that "The spark plug according to the embodiment is a small spark plug of which an outer diameter D of the plug screw 1a is 12mm or less. The outer diameter D is 10mm or more because of performance reasons."

Still further, paragraph [0028] of Publication 2 states that "The noble metal tip 52 is formed from Pt alloy (Pt-20Ir-2Ni). The tip diameter is 0.9mm, and the height is 0.3mm."

Still further, paragraph [0042] of Publication 2 states that "Regarding the noble metal tips 51 of which the respective end diameters G are 0.6mm, 0.9mm, and 1.2mm, the discharge gap A is changed to 0.7mm, 0.9mm, and 1.1mm."

In this way, Publication 2 describes the components A, B, C, D, E, F, H, I, J, K, L, M, O, P, Q, R, S, X, Z, AA, AB, AC, AD, AE, AF, AH, AI, AJ, AK, AL, AM, AO, AP, AQ, AR, AS, AX, AZ, BA, BB, BC, BD, BE, BG, BI, BK, BM, BN, BO, BP, BQ, BR, BS, BX, BY, and BZ of the present patent application.

(4) Explanation of Publication 3 (JP-A-H4-209968)

[Claim 1] in the [Scope of Claims] of Publication 3 states that "a duration time of an induction component of a spark discharge is 1.0msec or less and 0.2msec or more with spark energy of 20 millijoules or less and 5.0 millijoules or more,".

Furthermore, paragraph [0003] states that "It is known that the diameter of the firing part of the center electrode should be made small to simultaneously achieve a reduction of the required voltage of the spark plug and improve ignition performance."

In this way, Publication 3 describes the components G and AG of the present patent application.

(5) Explanation of Publication 4 (JP-A-2000-223239)

Paragraph [0050] of Publication 4 states that "FIG. 11 is a circuit diagram of a positive polarity ignition system. A battery 31 is connected to a primary coil of an ignition coil 34. The other end of the primary coil is grounded, via an igniter 33. The igniter 33 is connected to an engine control computer unit (ECU) 32 and controlled. A negative voltage side of the secondary coil of the ignition coil 34 is grounded, contrary to ordinary grounding, and the positive voltage side of the secondary coil is connected to the spark plug 20, via the high-voltage-resistant cable 35."

In this way, Publication 4 describes the components Y, AY, and BW of the present patent application.

(6) Explanation of Publication 5 (JP-A-2000-228322)

Paragraph [0045] of Publication 5 states that "the pencil coil is generally required to be inserted into a narrow plug hole of about ϕ19 to ϕ28mm. Therefore, the outer diameter of the coil to be inserted is about ϕ18 to ϕ27mm, including the side core."

In this way, Publication 5 describes the components V, AV, and BU of the present patent application.

5. Comparison between the present patent application and the inventions described in the publications

(1) Regarding claim 1

i) Identical features

The components A, B, C, D, E, and F in claim 1 of the present patent application are described in Publication 1 or Publication 2.

ii) Differences

The component G in claim 1 of the present patent application is not directly described in Publication 1 or Publication 2.

iii) Views regarding differences

However, paragraph [0011] of the present patent application specifications states that "It has been discovered than, if the one end section of the center electrode and the protruding section of the grounded electrode that face each other separated by the discharge gap are both cylindrical with narrow diameters of 2.3mm or less, the required ignition energy can be made smaller than the 17mJ required by the conventional ignition plug, at the maximum." In other words, the present patent application specifications states that, if the one end section of the center electrode and the protruding section of the grounded electrode in the spark plug are both cylindrical with narrow diameters of 2.3mm or less, the required ignition energy is less than 17mJ.

On the other hand, Publication 1 or Publication 2 describes a spark plug of which the diameters of both the one end section of the center electrode and the protruding section of the grounded electrode are 2.3mm or less. It is clear that the required ignition energy of the spark plug described in Publication 1 or Publication 2 is also less than 17mJ.

Therefore, it can be said that the component G in claim 1 of the present patent application specifications is effectively described in Publication 1 or Publication 2.

Publication 3 describes the spark energy as being 5mJ to 20mJ. It is a known technique to make the ignition energy less than 17mJ.

Furthermore, there is no technical reason for making the ignition energy less than 17mJ. Such a component G is merely a matter of design.

iv) Therefore, the invention according to claim 1 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the art on the basis of Publication 1 or Publication 2 or by a combination of Publication 1 or Publication 2 and Publications 3.

(2) Regarding claim 2

i) Identical features

The components H, I, J, K, L, and M in claim 2 of the present patent application are described in Publication 1 or Publication 2.

ii) Differences

The component N in claim 2 of the present patent application is not directly described in Publication 1 or Publication 2.

iii) Views regarding differences

However, paragraph [0013] of the present patent application specifications states that "The ignition energy density is made less than 32W by the one end section (31) of the center electrode (30) and the protruding section (41) of the grounded electrode (40) that face each other separated by the discharge gap (45) being both made cylindrical with narrow diameters of 2.3mm or less." In other words, the present patent application specifications states that, if the one end section of the center electrode and the protruding

section of the grounded electrode in the spark plug are both cylindrical with narrow diameters of 2.3mm or less, the ignition energy density is less than 32W.

On the other hand, Publication 1 or Publication 2 describes a spark plug of which the diameters of both the one end section of the center electrode and the protruding section of the grounded electrode are 2.3mm or less. It is clear that the ignition energy density of the spark plug described in Publication 1 or Publication 2 is less than 32W.

Therefore, it can be said that the component N in claim 2 of the present patent application specifications is effectively described in Publication 1 or Publication 2.

Publication 3 states that a duration time of an induction component of a spark discharge is 0.2msec to 1.0msec with spark energy of 5.0mJ to 20mJ. Here, from the description in paragraph [0071] of the present patent application specifications, energy density [W] is energy per unit of time [J/sec]. Therefore, when the energy density is calculated using the above-described values, it is clear that Publication 3 describes the energy density as being 5W to 100W. In other words, the Publication 3 states that the energy density is 5W to 100W. It is a known technique to make the ignition energy density less than 32W.

Furthermore, there is no technical reason for making the ignition energy density less than 32W. Such a component N is merely a matter of design.

iv) Therefore, the invention according to claim 2 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the art on the basis of Publication 1 or Publication 2 or by a combination of Publication 1 or Publication 2 and Publications 3.

(3) Regarding claim 3

i) Identical features

The component O in claim 3 of the present patent application is described in Publication 1 or Publication 2.

ii) Therefore, the invention according to claim 3 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the art on the basis of Publication 1 or Publication 2.

(4) Regarding claim 4

i) Identical features

The component P in claim 4 of the present patent application is described in Publication 2.

ii) Therefore, the invention according to claim 4 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the art on the basis of Publication 2.

(5) Regarding claim 5

i) Identical features

The component Q in claim 5 of the present patent application is described in Publication 1 or Publication 2.

ii) Therefore, the invention according to claim 5 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the art on the basis of Publication 1 or Publication 2.

(6) Regarding claim 6

i) Identical features

The component R in claim 6 of the present patent application is described in Publication 1 or Publication 2.

ii) Therefore, the invention according to claim 6 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the art on the basis of Publication 1 or Publication 2.

(7) Regarding claim 7

i) Identical features

The component S in claim 7 of the present patent application is described in Publication 1 or Publication 2.

ii) Therefore, the invention according to claim 7 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the art on the basis of Publication 1 or Publication 2.

(8) Regarding claim 8

i) Identical features

The component T in claim 8 of the present patent application is described in Publication 1.

ii) Therefore, the invention according to claim 8 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the art on the basis of Publication 1.

(9) Regarding claim 9

i) Identical features

The component U in claim 9 of the present patent application is described in Publication 1.

ii) Differences

The component V in claim 9 of the present patent application is not directly described in Publication 1.

iii) Views regarding differences

However, Publication 5 describes the diameter of the ignition coil as being made ϕ18mm to ϕ27mm. It is a known technique to make the diameter of the ignition coil ϕ22mm or less.

Furthermore, there is no technical reason for making the diameter of the ignition coil ϕ22mm or less. Such a component V is merely a matter of design.

iv) Therefore, the invention according to claim 9 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the art by a combination of Publication 1 and Publication 5.

(10) Regarding claim 10

i) Identical features

The components W and X in claim 10 of the present patent application are described in Publication 1.

ii) Differences

The component Y in claim 10 of the present patent application is not directly described in Publication 1.

iii) Views regarding differences

However, Publication 4 describes a positive polarity ignition system. It is a known technique to apply a positive voltage to the center electrode during discharge.

iv) Therefore, the invention according to claim 10 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the art by a combination of Publication 1 and Publication 4.

(11) Regarding claim 11

i) Identical features

The component Z in claim 11 of the present patent application is described in Publication 1 or Publication 2.

ii) Therefore, the invention according to claim 11 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the art on the basis of Publication 1 or Publication 2.

(12) Regarding claim 12

i) Identical features

The components AA, AB, AC, AD, AE, and AF in claim 12 of the present patent application are described in Publication 1 or Publication 2.

ii) Differences

The component AG in claim 1 of the present patent application is not directly described in Publication 1 or Publication 2.

iii) Views regarding differences

However, paragraph [0035] of the present patent application specifications states that "the invention according to claim 12 corresponds with the invention according to claim 1." In addition, paragraph [0036] states that "the one end section of the center electrode and the protruding section of the grounded electrode are both columnar, in which the cross-sectional areas of all cross-sections in a direction perpendicular to an axis are equal to or less than 4.2mm^2. The effect is the same in each corresponding invention." Here, paragraph [0011] of the present patent application specifications describes the effect according to the first embodiment as "the required ignition energy can be made smaller than the 17mJ required by conventional ignition plugs, at the maximum." In other words, if the one end section of the center electrode and the protruding section of the grounded electrode in the spark plug are both columnar, in which the cross-sectional areas of all cross-sections in a direction perpendicular to an axis are equal to or less than 4.2mm^2, the required ignition energy is less than 17mJ.

On the other hand, Publication 1 and Publication 2 describe a spark plug of which the cross-sectional areas of all cross-sections in a direction perpendicular to an axis of both the one end section of the center electrode and the protruding section of the grounded electrode are equal to or less than 4.2mm^2. It is clear that in the spark plugs described in Publication 1 and Publication 2, the required ignition energy is also less than 17mJ.

Therefore, it can be said that the component AG in claim 1 of the present patent application specifications is effectively described in Publication 1 or Publication 2.

Publication 3 describes the spark energy as being 5mJ to 20mJ. It is a known technique to make the ignition energy 17mJ or less.

Furthermore, there is no technical reason for making the ignition energy 17mJ or

less. Such a component AG is merely a matter of design.

iv) Therefore, the invention according to claim 12 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the art on the basis of Publication 1 or Publication 2 or by a combination of Publication 1 or Publication 2 and Publication 3.

(13) Regarding claim 13

i) Identical features

The components AH, AI, AJ, AK, AL, and AM in claim 13 of the present patent application are described in Publication 1 or Publication 2.

ii) Differences

The component AN in claim 13 of the present patent application is not directly described in Publication 1 or Publication 2.

iii) Views regarding differences

However, paragraph [0035] of the present patent application specifications states that "the invention according to claim 13 corresponds with the invention according to claim 2." In addition, paragraph [0036] states that "the one end section of the center electrode and the protruding section of the grounded electrode are both columnar, in which the cross-sectional areas of all cross-sections in a direction perpendicular to an axis are equal to or less than 4.2mm^2. The effect is the same in each corresponding invention." Here, paragraph [0013] of the present patent application specifications describes the effect according to the second embodiment as "the ignition energy density is less than 32W." In other words, if the one end section of the center electrode and the protruding section of the grounded electrode in the spark plug are both columnar, in which the cross-sectional areas of all cross-sections in a direction perpendicular to an axis are equal to or less than 4.2mm^2, the ignition energy density is less than 32W.

On the other hand, Publication 1 and Publication 2 describe a spark plug of which the cross-sectional areas of all cross-sections in a direction perpendicular to an axis of both the one end section of the center electrode and the protruding section of the grounded electrode are equal to or less than 4.2mm^2. It is clear that in the spark plugs described in Publication 1 and Publication 2, the ignition energy density is also less than 32W.

Therefore, it can be said that the component AN in claim 13 of the present patent application specifications is effectively described in Publication 1 or Publication 2.

Publication 3 states that the duration time of an induction component of a spark discharge is 0.2msec to 1.0msec with spark energy of 5.0mJ to 20mJ. Here, from the description in paragraph [0071] of the present patent application specifications, energy density [W] is energy per unit of time [J/sec]. Therefore, when the energy density is calculated using the above-described values, it is clear that Publication 3 describes the energy density as being 5W to 100W. In other words, the Publication 3 states that the energy density is 5W to 100W. It is a known technique to make the ignition energy density less than 32W.

Furthermore, there is no technical reason for making the ignition energy density less than 32W. Such a component AN is merely a matter of design.

iv) Therefore, the invention according to claim 13 of the present patent application does

not have inventive step since it could have easily been achieved by persons skilled in the art on the basis of Publication 1 or Publication 2 or by a combination of Publication 1 or Publication 2 and Publications 3.

(14) Regarding claim 14

i) Identical features

The component AO in claim 14 of the present patent application is described in Publication 1 or Publication 2.

ii) Therefore, the invention according to claim 14 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the art on the basis of Publication 1 or Publication 2.

(15) Regarding claim 15

i) Identical features

The component AP in claim 15 of the present patent application is described in Publication 2.

ii) Therefore, the invention according to claim 15 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the art on the basis of Publication 2.

(16) Regarding claim 16

i) Identical features

The component AQ in claim 16 of the present patent application is described in Publication 1 or Publication 2.

ii) Therefore, the invention according to claim 16 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the art on the basis of Publication 1 or Publication 2.

(17) Regarding claim 17

i) Identical features

The component AR in claim 17 of the present patent application is described in Publication 1 or Publication 2.

ii) Therefore, the invention according to claim 17 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the art on the basis of Publication 1 or Publication 2.

(18) Regarding claim 18

i) Identical features

The component AS in claim 18 of the present patent application is described in Publication 1 or Publication 2.

ii) Therefore, the invention according to claim 18 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the art on the basis of Publication 1 or Publication 2.

(19) Regarding claim 19

i) Identical features

The component AT in claim 19 of the present patent application is described in Publication 1.

ii) Therefore, the invention according to claim 19 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the

art on the basis of Publication 1.

(20) Regarding claim 20

i) Identical features

The component AU in claim 20 of the present patent application is described in Publication 1.

ii) Differences

The component AV in claim 20 of the present patent application is not directly described in Publication 1.

iii) Views regarding differences

However, Publication 5 describes the diameter of the ignition coil as being ϕ18mm to ϕ27mm. It is a known technique to make the diameter of the ignition coil ϕ22mm or less.

Furthermore, there is no technical reason for making the diameter of the ignition coil ϕ22mm or less. Such a component AV is merely a matter of design.

iv) Therefore, the invention according to claim 20 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the art by a combination of Publication 1 and Publication 5.

(21) Regarding claim 21

i) Identical features

The components AW and AX in claim 21 of the present patent application are described in Publication 1.

ii) Differences

The component AY in claim 21 of the present patent application is not directly described in Publication 1.

iii) Views regarding differences

However, Publication 4 describes a positive polarity ignition system. It is a known technique to apply a positive voltage to the center electrode during discharge.

iv) Therefore, the invention according to claim 21 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the art by a combination of Publication 1 and Publication 4.

(22) Regarding claim 22

i) Identical features

The component AZ in claim 22 of the present patent application is described in Publication 1 or Publication 2.

ii) Therefore, the invention according to claim 22 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the art on the basis of Publication 1 or Publication 2.

(23) Regarding claim 23

i) Identical features

The components BA, BB, BC, BD, and BE in claim 23 of the present patent application are described in Publication 2.

ii) Differences

The component BF in claim 23 of the present patent application is not directly described in Publication 2.

iii) Views regarding differences

However, Publication 2 describes the length h of the protruding section to be 0.3mm. It is clear that a spark plug that satisfies the lower limit of the relational expression $0.3(mm) \leq h \leq 0.016E^2-0.56E+5.2(mm)$ is described.

In addition, Publication 3 describes the spark energy as being 5mJ to 20mJ. It is a known technique to make the ignition energy E $8.5(mJ) \leq E \leq 17(mJ)$.

iv) Therefore, the invention according to claim 23 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the art by a combination of Publication 2 and Publication 3.

(24) Regarding claim 24

i) Identical features

The component BG in claim 24 of the present patent application is described in Publication 1 or Publication 2.

ii) Differences

The component BH in claim 24 of the present patent application is not directly described in Publication 1 or Publication 2.

iii) Views regarding differences

However, Publication 3 states that the duration time of an induction component of a spark discharge is 0.2msec to 1.0msec with spark energy of 5.0mJ to 20mJ. Here, from the description in paragraph [0071] of the present patent application specifications, energy density [W] is energy per unit of time [J/sec]. Therefore, when the energy density is calculated using the above-described values, it is clear that Publication 3 describes the energy density as being 5W to 100W. In other words, the Publication 3 states that the energy density is 5W to 100W. It is a known technique to make the ignition energy density less than 32W.

Furthermore, there is no technical reason for making the ignition energy density less than 32W. Such a component BH is merely a matter of design.

iv) Therefore, the invention according to claim 24 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the art by a combination of Publication 1 or Publication 2 and Publications 3.

(25) Regarding claim 25

The component BI in claim 25 of the present patent application is described in Publication 2.

ii) Differences

The component BJ in claim 25 of the present patent application is not directly described in Publication 2.

iii) Views regarding differences

Paragraph [0042] of the present patent application specifications states that ignitability as an ignition plug can be maintained while saving power when the relational expression $1.5D2^2+0.1D2+8(mJ) \leq E < 0.34D1^2+0.2D1+16.4(mJ)$ is satisfied. When ignition energy E is calculated by the diameter D1 of the one end section of the center electrode and the diameter D2 of the protruding section of the grounded electrode described in Publication 2 being assigned in the above-described relational expression, $9.305 \leq E < 16.6(mJ)$ when $(D1,D2)=(0.6,0.9)$, $9.305 \leq E < 16.9(mJ)$ when $(D1,D2)=(0.9,0.9)$,

and $9.305 \leq E < 17.1$(mJ) when (D1,D2)=(1.2,0.9). In other words, it is clear that, in the spark plug described in Publication 2, the ignition energy required for maintaining ignitability while saving power is 9.305mJ to 17.1mJ.

At the same time, Publication 3 describes the spark energy as being 5mJ to 20mJ. It is a known technique to make the ignition energy 9.305mJ to 17.1mJ.

Therefore, it is clear that an ignition device that satisfies the above-described relational expression can be obtained by the ignition device described in Publication 3 being applied to the spark plug described in Publication 2.

iv) Therefore, the invention according to claim 25 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the art by a combination of Publication 2 and Publication 3.

(26) Regarding claim 26

The component BK in claim 26 of the present patent application is described in Publication 2.

ii) Differences

The component BL in claim 26 of the present patent application is not directly described in Publication 2.

iii) Views regarding differences

Paragraph [0044] of the present patent application specifications states that ignitability as an ignition plug can be maintained while saving power when the relational expression $3D2^2+0.2D2^2+16(W) \leq Q < 0.68D1^2+0.4D1+32.8(W)$ is satisfied. When the ignition energy density Q is calculated by the diameter D1 of the one end section of the center electrode and the diameter D2 of the protruding section of the grounded electrode described in Publication 2 being assigned in the above-described relational expression, $18.6 \leq Q < 33.3$(mJ) when (D1,D2)=(0.6,0.9), $18.6 \leq Q < 33.7$(mJ) when (D1,D2)=(0.9,0.9), and $18.6 \leq Q < 34.3$(mJ) when (D1, D2)=(1.2,0.9). In other words, it is clear that, in the spark plug described in Publication 2, the ignition energy density required for maintaining ignitability while saving power is 18.6W to 34.3W.

At the same time, Publication 3 states that a duration time of an induction component of a spark discharge is 0.2msec to 1.0msec with spark energy of 5.0mJ to 20mJ. Here, from the description in paragraph [0071] of the present patent application specifications, energy density [W] is energy per unit of time [J/sec]. Therefore, when the energy density is calculated using the above-described values, it is clear that Publication 3 describes the energy density as being 5W to 100W. In other words, the Publication 3 states that the energy density is 5W to 100W. It is a known technique to make the ignition energy density 18.6W to 34.3W.

Therefore, it is clear that an ignition device that satisfies the above-described relational expression can be obtained by the ignition device described in Publication 3 being applied to the spark plug described in Publication 2.

iv) Therefore, the invention according to claim 26 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the art by a combination of Publication 2 and Publication 3.

(27) Regarding claim 27

i) Identical features

The components BM and BN in claim 27 of the present patent application are described in Publication 1 or Publication 2.

ii) Therefore, the invention according to claim 27 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the art on the basis of Publication 1 or Publication 2.

(28) Regarding claim 28

i) Identical features

The component BO in claim 28 of the present patent application is described in Publication 2.

ii) Therefore, the invention according to claim 28 of the present patent application does not have inventive step since it could have easily been made by persons skilled in the art on the basis of Publication 2.

(29) Regarding claim 29

i) Identical features

The component BP in claim 29 of the present patent application is described in Publication 1 or Publication 2.

ii) Therefore, the invention according to claim 29 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the art on the basis of Publication 1 or Publication 2.

(30) Regarding claim 30

i) Identical features

The component BQ in claim 30 of the present patent application is described in Publication 1 or Publication 2.

ii) Therefore, the invention according to claim 30 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the art on the basis of Publication 1 or Publication 2.

(31) Regarding claim 31

i) Identical features

The component BR in claim 31 of the present patent application is described in Publication 1 or Publication 2.

ii) Therefore, the invention according to claim 31 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the art on the basis of Publication 1 or Publication 2.

(32) Regarding claim 32

i) Identical features

The components BS and BT in claim 32 of the present patent application are described in Publication 1.

ii) Differences

The component BU in claim 32 of the present patent application is not directly described in Publication 1.

iii) Views regarding differences

However, Publication 5 describes the diameter of the ignition coil as being ϕ18mm to ϕ27mm. It is a known technique to make the diameter of the ignition coil ϕ22mm or less.

Furthermore, there is no technical reason for making the diameter of the ignition coil ϕ22mm or less. Such a component BU is merely a matter of design.

iv) Therefore, the invention according to claim 32 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the art by a combination of Publication 1 and Publication 5.

(33) Regarding claim 33

i) Identical features

The component BV in claim 33 of the present patent application is described in Publication 1.

ii) Differences

The component BW in claim 33 of the present patent application is not directly described in Publication 1.

iii) Views regarding differences

However, Publication 4 describes a positive polarity ignition system. It is a known technique to apply a positive voltage to the center electrode during discharge.

iv) Therefore, the invention according to claim 33 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the art by a combination of Publication 1 and Publication 4.

(34) Regarding claim 34

i) Identical features

The component BX in claim 34 of the present patent application is described in Publication 1 or Publication 2.

ii) Therefore, the invention according to claim 34 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the art on the basis of Publication 1 or Publication 2.

(35) Regarding claim 35

i) Identical features

The component BY in claim 35 of the present patent application is described in Publication 2.

ii) Therefore, the invention according to claim 35 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the art on the basis of Publication 2.

(36) Regarding claim 36

i) Identical features

The component BZ in claim 36 of the present patent application is described in Publication 2.

ii) Therefore, the invention according to claim 36 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the art on the basis of Publication 2.

(37) Regarding claim 37

i) Identical features

The component CA in claim 37 of the present patent application is described in Publication 1.

ii) Therefore, the invention according to claim 37 of the present patent application does

not have inventive step since it could have easily been achieved by persons skilled in the art on the basis of Publication 1.

(38) Regarding claim 38

i) Identical features

The component CB in claim 38 of the present patent application is described in Publication 1.

ii) Therefore, the invention according to claim 38 of the present patent application does not have inventive step since it could have easily been achieved by persons skilled in the art on the basis of Publication 1.

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